

ATOMIC TIME SCALES TAI AND TT(BIPM): PRESENT STATUS AND PROSPECTS

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Abstract

International Atomic Time TAI gets its stability from some 350 atomic clocks worldwide that generate the free atomic scale EAL and its accuracy from a small number of primary frequency standards (PFS) which frequency measurements are used to steer the EAL frequency. Because TAI is computed in "real-time" (every month) and has operational constraints, it is not optimal and the BIPM computes in deferred time another time scale TT(BIPM), which is based on a weighted average of the evaluations of TAI frequency by the PFS.

Several years ago, a point had been reached where the stability of atomic time scales, the accuracy of primary frequency standards, and the capabilities of frequency transfer were at a similar level, at that time about 1×10^{-15} in relative frequency. The goal is now to reach 1×10^{-16} and the three fields are in various stages of advancement towards this aim.

We review the stability and accuracy recently achieved by frequency standards, focusing on primary frequency standards on one hand, and on new realizations based on optical transitions on the other hand. We study if and how these performances translate to the performance of atomic time scales, and the possible implications of the availability of new high-accuracy frequency standards operating on a regular basis.

Finally we show how time transfer is trying to keep up with the progresses of frequency standards. Present operational techniques, GNSS and Two-way time transfer, have steadily improved but new techniques will be needed to keep in line with the performances of frequency standards. Some of them will be described.